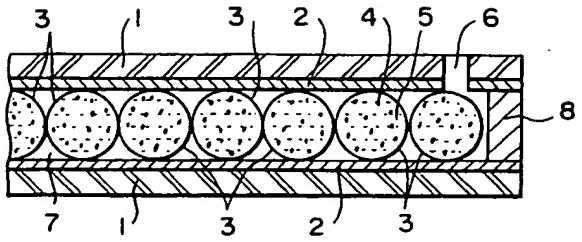
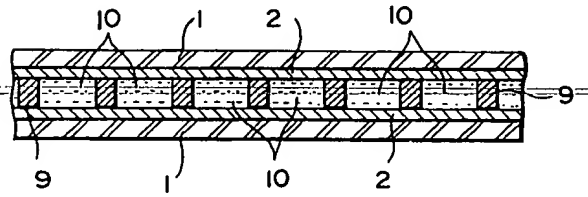
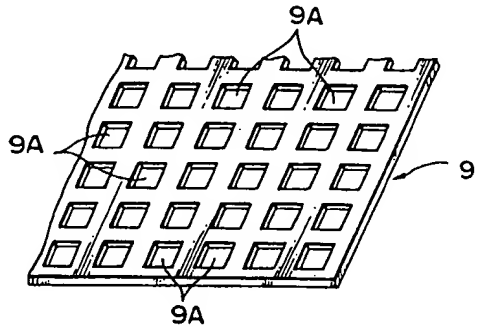
第 1 図



第 2 図



第 3 図



⑲日本国特許庁(JP)　⑪特許出願公開

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審査請求　未請求　発明の数 1　(全4頁)

㊹発明の名称　電気泳動表示装置

㉑特　願　昭62-244679

㉒出　願　昭62(1987)9月29日

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明　細　書

1. 発明の名称

電気泳動表示装置

2. 特許請求の範囲

(1) 少なくとも一方が透明な一組の対向電極板間に電気泳動粒子を含む分散系を封入し、該電極間に印加した表示制御用電圧の作用下に分散系内の電気泳動粒子の分布状態を変えることによって光学的反射特性に変化を与えて所要の表示動作を行わせるようにした電気泳動表示装置に於いて、着色した分散媒中に該分散媒と光学的特性の異なる少なくとも一種類の電気泳動粒子を分散させた分散系を封入した多数のマイクロカプセルを設け、これらのマイクロカプセルを上記電極板間に配装するように構成したことを特徴とする電気泳動表示装置。

(2) 上記分散系及びマイクロカプセルの膜の体積抵抗率を実質上同等に形成するように構成したことを特徴とする特許請求の範囲第(1)に記載の電気泳動表示装置。

3. 発明の詳細な説明

「産業上の利用分野」

本発明は、電気泳動粒子を利用した表示装置に関し、更に詳細に云えば、分散媒中に電気泳動粒子を分散させた分散系をマイクロカプセルに個々に封入し、これらのマイクロカプセルを電極板間に配装するようにした電気泳動表示装置に関する。

「従来技術とその問題点」

電気泳動粒子を使用したこの種の電気泳動表示装置は、少なくとも一方が透明な対向配置した一組の電極板間に液体分散媒に電気泳動粒子を分散させた分散系を封入し、上記電極板の極性に応じて分散媒中の電気泳動粒子を透明電極板側に吸着又は離反させるように該極性を制御することにより、所望の文字、記号或いは図形等を表示できるように構成されている。分散系に使用される液体分散媒には、アルコール系溶媒、各種エステル類、脂肪族炭化水素、脂環式炭化水素、芳香族炭化水素、ハロゲン化炭化水素又はその他の種々の油等を単独又は適宜混合したものに界面活性剤などを

適量添加したものを使用できる。また、電気泳動粒子としては、カーボンブラック、紺青又はフタロシアニングリーン等が一般的なものとして知られている。

第２図は、斯かる電気泳動表示装置の概念的な要部断面構成図を示し、１及び２はガラス板等の透明部材とその一方面に所要のパターンで形成された透明電極であって、対向配置されたこれらの一組の透明電極２の間には、電気泳動粒子を含む分散系１０を封入してある。ここで、分散系１０を単に両電極２間に封入する構造では、電気泳動粒子の凝集や付着現象によって表示ムラを発生する恐れがあるので、このような事態を防止できる手段として、両電極２間に第３図の如き適宜形状の透孔９Ａを多数形成したメッシュ状或いは多孔質状の有孔性スペーサ９を配置することにより、分散系１０を不連続に分割し、以って表示動作の安定化を図るようにした構造も知られている。

有孔性スペーサ９を備える電気泳動表示装置では、両透明電極２間に該有孔性スペーサ９を介装した後、この有孔性スペーサ９に形成された多数の各透孔９Ａに分散系１０を封入するものであるが、これら多数の各透孔９Ａに対する分散系１０の一様な封入処理は極めて困難である。そこで、一方の透明電極２に有孔性スペーサ９を形成した後、各透孔９Ａに分散系１０を滴下又は塗布したうえ、他方の透明電極２を配置して封止するという手法も考慮できるが、分散系１０に一般的に用いられる分散媒は気化し易い為、このような手法では分散系１０の特性が変化して再現性を確保することが困難であるという問題がある。

「発明の目的及び構成」

本発明は、上記のような有孔性スペーサなどを使用することなく、分散系を予めマイクロカプセル化する手法を採用することによって、透明電極間に封入した分散系に関連する上記の如き種々の問題点を好適に解消し、分散系封入処理の容易化と任意なカラー表示等を含む良好な電気泳動表示動作を確実に達成可能な電気泳動表示装置を提供するものである。

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このような目的を達成する為に、本発明に係る電気泳動表示装置では、少なくとも一方が透明な一組の対向電極板間に電気泳動粒子を含む分散系を封入し、該電極間に印加した表示制御用電圧の作用下に分散系内の電気泳動粒子の分布状態を変えることによって光学的反射特性に変化を与えて所要の表示動作を行わせる電気泳動表示装置に於いて、着色した分散媒中に該分散媒と光学的特性の異なる少なくとも一種類の電気泳動粒子を分散させた分散系を封入した多数のマイクロカプセルを形成し、これらのマイクロカプセルを上記電極板間に配装するように構成したものであり、ここで、上記分散系及びマイクロカプセルの膜の体積抵抗率は実質上同等に形成するのが好適である。

「実　施　例」

以下、第１図に示す一実施例を参照しながら本発明を更に詳細に説明する。同図に於いて、一組のガラス板等からなる透明部材１の対向面に各々形成された透明電極２の間には、電気泳動粒子４を分散媒中に分散させた分散系５を予めマイクロカプセル化手法で個々に封入した多数のマイクロカプセル３を配装するように構成してある。ここで、マイクロカプセル３に封入すべき分散系５の電気泳動粒子４としては、周知のコロイド粒子のほか、種々の有機・無機顔料、染料、金属粉、ガラス或いは樹脂等の微粉末などを適宜使用できる。また、分散系５の分散媒には、水、アルコール類、炭化水素、ハロゲン化炭化水素等のほか、天然又は合成の各種の油などを使用できる。このような分散系５中には、必要に応じて、電解質や界面活性剤、金属石けん、樹脂、ゴム、油、ワニス、コンパウンドなどの粒子からなる荷電制御剤に加えて分散剤、潤滑剤、安定化剤等を添加できる。更に、電気泳動を行なう泳動粒子４の荷電を正又は負に統一したり、ゼータ電位を高める手段や分散を均一安定化することの他、電気泳動粒子４の透明電極２に対する吸着性や分散媒の粘度等の調整を適宜行うことが出来る。

このようにして構成される分散系５は、ボールミル、サンドミル、ペイントシェーカ等の適当な

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手段で十分に硬和した後、界面重合法、不溶化反応法、相分離法或いは界面沈澱法などの適宜手法で分散系5をマイクロカプセル化する。この場合、マイクロカプセル3の膜と分散系5の体積抵抗率は実質上同等となるように構成するのが好ましい。

このようにして得られたマイクロカプセル3は、スクリーン印刷手段、ローラー印刷手段或いはスプレー法などの手法を用いて一方の透明電極2上に整列させた後、他方の透明電極2と組合せて両電極2間に封入することができる。マイクロカプセル3による分散系5の両電極2間への斯かる封入処理は上記手法の他、両電極2間に連通する適当な封入孔を用いて所要量のマイクロカプセル3を注入するような手段も採用できる。

また、マイクロカプセル3相互の間隙及び電極2とマイクロカプセル3との間隙には、マイクロカプセル3に対して化学的に安定であって屈折率及び体積抵抗率が実質上等しい物質7を第1図の如く注入孔6を介して満たすように構成するのが実用上好ましい。なお、8は端部封止材を示す。

「発明の効果」

本発明に係る電気泳動表示装置は、上記のとおり、分散系を予めマイクロカプセル化し、このマイクロカプセルを表示制御用電極間に配装するように構成したことを特徴とするので、少なくとも次の効果を奏する。

マイクロカプセル化した分散系の組成は、一様に保持される為、従来の如き電気泳動粒子の凝集或いは電極に対する付着現象を解消して、均一且つ安定した表示動作を達成可能である。

表示制御用電極間にマイクロカプセルを配列する構造を備えるので、組立時等に分散系に悪影響を与えることなく、分散系の取り扱い或いは分散系封入処理を格段に改善して特性の良好な電気泳動表示装置を提供できる。

分散系を予めマイクロカプセル化する際、種々表示色の異なる分散系を種類毎に製造することが可能であり、斯かる表示色の異なるマイクロカプセルを適宜配列して所望のカラー表示を達成でき、その際、隔壁又は仕切り手段等も不要である。

4. 図面の簡単な説明

第1図は本発明の一実施例に従って構成された分散系封入用マイクロカプセルを備えた電気泳動表示装置の概念的な要部断面構成図、

第2図は有孔性スペーサを具備する従来構造に従った電気泳動表示装置の概念的な要部断面構成図、そして、

第3図は有孔性スペーサの構成例の部分斜視説明図である。

1 ： 透明部材
2 ： 透明電極
3 ： マイクロカプセル
4 ： 泳動粒子
5 ： 分散系
9 ： 有孔性スペーサ
10 ： 分散系

PAT-NO: JP401086116A

DOCUMENT-IDENTIFIER: JP 01086116 A

TITLE: ELECTROPHORETIC DISPLAY DEVICE

PUBN-DATE: March 30, 1989

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APPL-NO: JP62244679

APPL-DATE: September 29, 1987

INT-CL (IPC): G02F001/19, G09F009/00

US-CL-CURRENT: 345/107, 349/155 , 359/615

ABSTRACT:

PURPOSE: To facilitate the sealing treatment of a dispersion system and to assure a good electrophoretic display operation by adopting a technique to previously microcapsulate the dispersion system.

CONSTITUTION: The dispersion system 5 is previously microcapsulated and the microcapsules 3 are disposed between electrodes for display control. Since the compsn. of the microcapsulated dispersion system 5 are uniformly held and,

therefore, the flocculation of the electrophoresis particles or the sticking thereof to electrodes is eliminated and the uniform and stable display operation is accomplished. The handling of the dispersion system 5 or the sealing treatment of the dispersion system 5 is greatly improved without adversely affect the dispersion system 5 at the time of assembly. The electrophoretic display device having good characteristics is thus obtd.

Job1643

19. Japan Patent Office (JP) 12. **Japan Laid-open Patent Gazette (A)** 11. Patent Application Laid-open No.

Showa 64-86116 (1989)

43. Patent Laid-open March 30, 1989 (Showa 64)

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				Number of Claims: 1

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54. Title of Invention: Electrophoretic Display Device

21. Application No.: Showa 62-244679

22. Date of Filing: September 29, 1987 (Showa 62)

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Specification

1. Title of the Invention

Electrophoretic Display Device

2. Claims of Patent

(1) An electrophoretic display device wherein the space between a pair of opposing electrode plates at least one of which is transparent is filled with a disperse system containing electrophoretic particles, and the state of distribution of the electrophoretic particles in the disperse system is changed under the action of a display-

[1] ILS Note – An alternative way of reading this personal name is Shu.
[2] ILS Note - Despite an exhaustive search of available resources, we were unable to verify the Official company name. Phonetic translation is provided. Hereafter denoted as *.
[3] ILS Note – Alternative ways of reading this personal name are Akashi, Sho, and Teru.
[4] ILS Note – An alternative way of reading this personal name is Koshi.
[5] ILS Note – Alternative ways of reading this personal name are Takashi and Hisayuki.

controlling voltage applied across said electrodes in order to change the optical reflection properties and thereby to induce a specific display operation; in which are provided numerous microcapsules filled with a disperse system in which is dispersed, in a colored dispersion medium, at least one kind of electrophoretic particles the optical characteristics of which differ from those of said dispersion medium; with said device configured such that these microcapsules are arranged between the abovementioned electrode plates.

(2) An electrophoretic display device of Claim (1) of the present invention, wherein the volume resistivities of the abovementioned disperse system and microcapsules are for practical purposes the same.

3. Detailed Explanation of the Invention

(Field of Industrial Application)

The present invention concerns a display device utilizing electrophoretic particles; more precisely, it concerns an electrophoretic display device in which individual microcapsules are filled with a disperse system in which electrophoretic particles are dispersed in a dispersion medium, and these microcapsules are placed in the space between electrode plates.

(Prior Art and Problems Therewith)

In this type of electrophoretic display device using electrophoretic particles, the space between a pair of opposing electrode plates at least one of which is transparent is filled with a disperse system in which electrophoretic particles are dispersed in a liquid dispersion medium, and the electrophoretic particles in the dispersion medium are made to adhere to or be repelled from the transparent electrode plate side according to the polarity of said electrode plates, so that by controlling said polarity, any desired characters, symbols or figures can be displayed. As the liquid dispersion medium used in the disperse system, an alcohol solvent, various esters, aliphatichydrocarbons, alicyclic hydrocarbons, aromatic hydrocarbons, halogenated hydrocarbons, or various other hydrocarbons may be used either individually or in an appropriate mixture, with a surfactant added in an appropriate quantity. As the electrophoretic particles, carbon black, iron blue[6], phthalocyanine green, and other materials are known as general-use materials.

Figure 2 is a conceptual cross-sectional diagram of the main components of the electrophoretic display device in question. Here 1 and 2 are respectively glass sheets or some other transparent material, and transparent electrodes formed in the required pattern on one side; the space between this pair of transparent electrodes 2, placed to oppose each other, is filled with a disperse system 10 containing electrophoretic particles. In a construction in which the disperse system 10 simply fills the space between the electrodes, coagulation of the electrophoretic particles and adhesion phenomena may cause display unevenness; as methods of preventing such occurrences, constructions are known in which mesh-shaped spacers[7] 9 with numerous holes of an appropriate shape 9A as shown in Fig. 3, or perforated spacers 9 with numerous penetrating holes, are placed between the two electrodes 2, in order to divide the disperse system 10 into discontinuous areas and thereby stabilize the display operation.

In an electrophoretic display device provided with said perforated spacers 9, after placing said perforated spacers 9 between both transparent electrodes 2, each of the penetrating holes 9A formed in the perforated spacer 9 is filled with the disperse system 10; however, it is extremely difficult to uniformly fill the numerous penetrating holes 9A with the disperse system 10. One method which may be considered is to drip the disperse

[6] ILS Note – Alternative translations for this term are "Milori blue" and "navy blue."

[7] ILS Note – Although we have assumed that this term is plural, the Japanese text does not explicitly state whether multiple spacers are used.

system 10 onto or apply the disperse system 10 to each of the penetrating holes 9A after the perforated spacers 9 are formed on one of the transparent electrodes 2; but the dispersion media generally used in the disperse system 10 are easily vaporized, so that when using this method the characteristics of the disperse system 10 change and it is difficult to maintain reproducibility.

(Purpose of the Invention and Constitution)

Instead of using the above-described perforated spacers or similar parts, the present invention employs a method in which the disperse system is enclosed in microcapsules in advance. By this means an electrophoretic display device is offered in which the various above-described problems relating to the disperse system filling the space between transparent electrodes are satisfactorily eliminated, the process of inserting the disperse system is simplified, and good-quality electrophoretic display operation, including display of arbitrary colors, can be achieved reliably.

In order to attain this goal, in the electrophoretic display device of the present invention, the space between a pair of opposing electrode plates at least one of which is transparent is filled with a disperse system containing electrophoretic particles, and under the action of a voltage for display control which is applied across said electrodes, the distribution states of the electrophoretic particles within the dispersive system are changed, to alter the optical reflection properties and induce so-called display operation; and in this device are formed numerous microcapsules, which are filled with a dispersive system consisting of a colored dispersion medium in which are dispersed at least one type of electrophoretic particle with optical properties differing from said dispersion medium, with said microcapsules arranged between the abovementioned electrode plates. Here it is desirable that the volume resistivities of the abovementioned dispersive system and the microcapsule film are practically equal.

(Embodiment)

The present invention is explained in further detail below, referring to the embodiment shown in Fig. 1. In the figure, numerous microcapsules 3, each filled in advance by a microcapsule process with a disperse system 5 in which electrophoretic particles 4 are dispersed in a dispersion medium, are placed between the transparent electrodes 2 formed on the opposing surfaces of a pair of transparent sheets consisting of glass sheets or some other material. Here, the electrophoretic particles 4 of the disperse system 5 used to fill the microcapsules 3 may be, in addition to well-known colloidal particles, various other organic or inorganic pigments, dyes, metal powders, glass, resin or other fine powders, as appropriate. As the dispersion medium of the dispersive system 5, in addition to water, alcohols, hydrocarbons and halogenated hydrocarbons, various natural or synthesized hydrocarbons may also be used. To this dispersive system 5 may be added, as necessary, electrolytic materials, surfactants, metal soaps, resins, rubbers, hydrocarbons, varnish, compounds, and other charge-controlling agents consisting of particles, as well as dispersive agents, lubricants, stabilizing agents and other materials. Moreover, in addition to unifying the electric charge on the electrophoretic particles 4 undergoing electrophoresis at positive or negative charges and employing measures to raise the zeta potential or uniformly stabilize the dispersion, the adhesion to the transparent electrodes 2 of the electrophoretic particles 4 or the viscosity or other properties of the dispersion medium may be adjusted as appropriate.

The disperse system 5 with this composition is mixed thoroughly using a ball mill, sand mill, paint shaker or other appropriate means, and then a suitable method, such as interfacial polymerization, insolubilization reaction, phase separation, or interfacial precipitation, is used to enclose the disperse system 5 in microcapsules. Here, it is desirable that the volume resistivities of the film of the microcapsules 3 and the disperse system 5 be for practical purposes the same.

Microcapsules 3 obtained by this means are arranged on one of the transparent electrodes using a roller printing technique, a spray technique or some other method, and this may then be combined with the other transparent electrode 2 to fill the space between the two electrodes 2 with the microcapsules. In addition to the above means of filling the space between the electrodes 2 with the disperse system 5 using microcapsules 3, a method can also be employed in which appropriate filling holes linking the two electrodes are used to inject appropriate quantities of microcapsules 3.

In addition, for practical purposes it is desirable that the gaps between microcapsules 3 and the gaps between electrodes 2 and microcapsules 3 be filled via injection holes 6 with a material 7 which is chemically stable with respect to the microcapsules 3, and has for practical purposes the same refractive index and volume resistivity, as shown in Fig. 1. Here 8 denotes end sealing material.

(Effects of the Invention)

In an electrophoretic display device of the present invention, as has been described, the disperse system is encapsulated in microcapsules in advance, and these microcapsules are arranged in a plane between the electrodes used for display control. Consequently, there are at least the following advantageous results.

Because the composition of the disperse system in microcapsules is maintained to be uniform, coagulation of the electrophoretic particles or adhesion to the electrodes as in devices of the prior art are eliminated, and uniform and stable display operation is possible.

The device is constructed such that microcapsules are arranged between the electrodes used for display control, so that handling of the disperse system and processes for filling the space between the electrodes with the disperse system during assembly can be greatly improved without the need to consider adverse effects on the disperse system, to obtain an electrophoretic display device with satisfactory characteristics.

In encapsulating the disperse systems in microcapsules in advance, it is possible to produce disperse systems with various display colors, and appropriately arrange microcapsules with these different display colors to configure a desired color display; in doing so, no barrier walls or means of partitioning are needed.

4. Brief Explanation of the Drawings

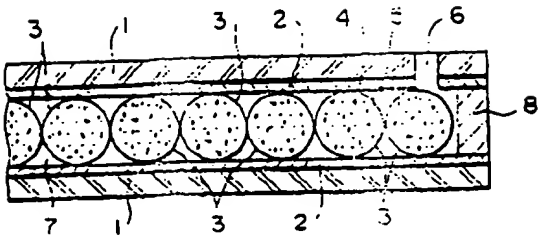
Figure 1 is a conceptual cross-sectional diagram of the main components of an electrophoretic display device provided with microcapsules filled with a disperse system, according to the Embodiment of the present invention;

Figure 2 is a conceptual cross-sectional diagram of the main components of an electrophoretic display device of the prior art, provided with perforated spacers; and,

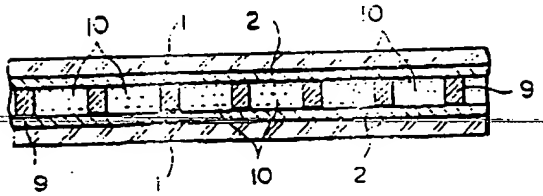
Figure 3 is a partial explanatory isometric diagram of an example of the construction of a perforated spacer.

1: Transparent material
2: Transparent electrode
3: Microcapsule
4: Electrophoretic particles
5: Disperse system
9: Perforated spacer
10: Disperse system

第 1 図



第 2 図



第 3 図